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(72) Inventor SIMONNE JUNE KERR

(54) APPARATUS FOR ELECTROSTATIC SPRAY COATING

(71) We, AIR-O-STATIC INC., 27 Locust Avenue, Wallington, New Jersey, 07057, United States of America; a corporation organized and existing under the laws of the State of New Jersey, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to improvements in electrostatic spray systems, and in particular to a novel and improved apparatus for spray coating articles wherein the deposition of the coating material is accomplished by means of electrostatic forces.

In the application of liquid materials, protective coatings, paints, finishing materials, fungicides, bacterial solutions, and the like, in the form of a spray to various articles, it is well-known to provide an electrostatic field between a charging electrode and the article to be coated, the electrostatic field serving to charge the spray particles and deposit them upon the article to be coated. Such a spray system has found widespread use particularly in the field of paint spraying, because of the efficiency of the electrostatic field in depositing the spray upon the object to be coated.

In the more recent developments of electrostatic spray deposition, an atomizer head is provided and is maintained at a very high electrical potential thereby serving as the charging electrode, while the article to be coated is maintained at ground potential, thereby creating a strong electrostatic field between the spray head and the work. If the applied voltage is sufficient, the field is effective to direct the liquid spray toward the grounded article to be coated and to deposit the spray on said article with very high efficiency.

While in some systems, the coating materials are atomized mechanically, as by means of a conventional air spray gun, and the atomized particles are propelled physically in the electrostatic field between an independent charging electrode or grid and the article to be coated, where the atomizer head itself is maintained at high potential to become the charging electrode of the field, the coating material thereon would atomize by means of electrostatic forces if the material was formed in a thin film having a sharp edge. Such electrostatic atomization is advantageous in that it avoids the necessity of providing means for mechanical atomization. In commercial use, the atomizer head is usually in the form of a disc or cup which is rotated by a motor to feed the coating material in the form of a fine film to its edge.

The provision of an atomizer head at high potential has its limitations and disadvantages. While deposition efficiency of the atomized spray increases with the increase of voltages employed, where electrostatic atomization is employed, it has been shown that there is a maximum potential gradient, above which the quality of atomization deteriorates. Thus deposition of the coating material suffers due to the requirements of electrostatic atomization. Further, where the atomizer head is maintained at a high potential and the articles to be coated are grounded, there is a tendency for arcing between the atomizer head and the articles, particularly where the head is brought close to the articles or where the articles are carried on a conveyor and swing toward the atomizer head. Since most coating compositions are combustible and some are highly inflammable, such arcing incurs a serious fire or explosion hazard. In addition, where the atomizer head is maintained at high potential, the coating material feed lines, pump and controls, as well as air and motor controls are also at high potential, presenting a serious shock hazard when they are approached by the operator.

It has been thought necessary to maintain a high potential gradient between the atomizer head and the article to be coated in order to obtain proper electrostatic deposition, even

where the coating material was atomized by mechanical means. Thus, if both the atomizer head and article to be coated were maintained at the same potential in an electrostatic field, it would be expected that the atomized paint would, under the influence of the field, be directed away from the article to be coated rather than toward it. It has been found, however, that where both the article to be coated and the atomizer head are maintained at the same potential, preferably gound potential, and electrostatic field of suitable geometry is created surrounding these members, the field may be made effective to deposit the atomized coating material on the article with even greater efficiency than in the previous systems.

It is an object of the present invention, therefore to provide an electrostatic spray coating system wherein the coating material is centrifugally atomized from an atomizer head and wherein both the atomizer head and article to be coated are maintained at the same potential, preferably ground potential. In such an arrangement, there is no tendency for sparking or arcing between the atomizer head and the article to be coated, and the danger of shock to the operator in approaching or touching the atomizer head and its associated parts and controls is minimized.

Another object of the invention is the provision of an electrostatic spray coating system of the character described in which a rotary centrifugal atomizer head is employed together with a drive motor sufficient to rotate the head at extremely high velocities, thereby producing by centrifugal means atomized particles of a size smaller than that obtainable by electrostatic atomization. Since the centrifugal atomization is independent of the electrostatic forces of the surrounding field, there is no limit on the potential gradient of the field, and optimum deposition of the atomized spray may be obtained.

In accordance with the invention, there is provided an electrostatic spray coating system including an atomizer unit having a rotary head, means to feed coating material to said head and means for rotating said head to atomize the coating material centrifugally in the form of a fine spray flung radially from said head. One or more charging electrodes are located a short distance rearwardly of said head and spaced outwardly thereof, the charging electrodes being maintained at a high potential relative to an article to be coated which is spaced forwardly of said head and is preferably grounded. The atomizer head is also grounded and maintained at the same potential as the article to be coated. A strong electrostatic field is created between the charging electrode and the article to be coated outwardly of and surrounding the atomizer head in such a manner that when the atomized spray is propelled radially from the atomizer head, it enters this electrostatic field and is carried thereby to the article to be coated, being deposited on the latter. Means may be provided to supply a shroud of air under pressure around the atomized spray, the air shroud providing a forward component of movement to the spray, concentrating the same, and dampening its radial movement so that it is prevented from travelling radially through the field without coming under the influence thereof.

Additional objects and advantages of the invention will become apparent during the course of the following specification when taken in connection with the accompanying drawings, in which:

FIG. 1 is a side elevational view of a spray assembly made in accordance with the present invention and indicating the electrostatic fields which exist during the operation thereof, portions of the assembly being broken away or shown schematically for convenience of illustration;

FIG. 2 is a side elevational view of the atomizer unit and charging electrodes utilized in the assembly of FIG. 1, with portions thereof broken away;

FIG. 3 is a section taken along line 3—3 of FIG. 2;

FIG. 4 is a section taken along line 4—4 of FIG. 2;

FIG. 5 is an enlarged partial side elevational view, partially broken away and shown in section, of a modified form of charging electrode which may be employed in the spray assembly; and

FIG. 6 is an enlarged partial side elevational view, partially broken away and shown in section, of still another form of charging electrode.

Referring in detail to the drawings, and in particular to FIG. 1, there is shown a liquid spray coating system employing an atomizer unit 10 having a rotatable atomizer head 12, an article 14 to be coated, and charging electrodes 16 therefor. The atomizer unit 10 is mounted on a support arm 18 mounted on a stand, pedestal, or reciprocating apparatus (not shown).

The atomizer unit 10 contains an air motor which rotates the atomizer head 12 at high speed so that the liquid coating material fed thereto is atomized centrifugally. A pipe or conduit 20 connects the air motor to a source of air under pressure (not shown) such as a conventional air pump, for driving the motor. The source of air also supplies air under pressure to the interior of the atomizer unit 10 through pipe or conduit 22 for supplying a shroud of air around the spray of liquid coating material atomized by the head 12, in a manner to be presently described. The liquid coating material is supplied to the interior of atomizer unit 10 and thence to the atomizer head 12 through a pipe or conduit 24 connected to a liquid supply pump (not shown) of the usual type. In addition, a conductive cable